PATENT SPECIFICATION (11) 1 427 194

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(21) Application No. 22550/73 (22) Filed 11 May 1973
(31) Convention Application No. 7 306 224 (32) Filed 22 Feb. 1973 in (33) France (FR)
(44) Complete Specification published 10 March 1976
(51) INT. CL.² B62D 53/02
(52) Index at acceptance B7H A2E1B A2E2A A2E6 C10K3 C4A2D P5 P7AU V2C V4C

(19)

(54) IMPROVEMENTS IN OR RELATING TO ARTICULATED VEHICLES

(71) We, ESTABLISSEMENTS BRAUD & FAUCHEUX S.A., a French Body Corporate, of Avenue de la Liberation, 44 150 — Ancenis, (Loire-Atlantique), France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to vehicles suitable for use on all kinds of ground, which vehicles comprise a leading chassis and a trailing chassis coupled together.

Articulated vehicles suitable for use on all kinds of ground — such as cross-country vehicles — generally have a driving position provided on the part ahead of the articulation and the power unit on the part behind the articulation. Power from the power unit can be transmitted mechanically, hydraulically or electrically to the point of utilization, and may be used for operating auxiliary equipment — such as fork lifts, hoists, excavators and so on — as well as for propulsion of the vehicle. The power transmission means requires means to control its distribution and regulation, and this is generally effected from the driving seat.

In order to allow the vehicle to be driven over all kinds of ground, the coupling connecting and articulating together the two parts of the vehicle must be capable of allowing the two parts to move relative to one another both about a normally vertical axis (for steering) and a normally horizontal axis (for taking up ground unevenness).

However, in such a vehicle, it is necessary to provide pipes, tubes and control means — such as cables — which pass from the leading chassis to the trailing chassis. During manoeuvring, and when there are large variations in the level of the ground, the articulated chassis are forced to occupy very varied angular positions and which change rapidly, so that the pipes, tubes and control means, which are particularly exposed in the connecting region, are liable to be damaged, and must be capable of withstanding frequent flexing. Special protection devices have been provided, but these complicate the chassis junction, increase the manufacturing cost of the vehicle and only partially remove the dangers of damage.

The invention aims at providing an economic and useful solution to the difficulty of coupling together the two chassis of a vehicle having leading and trailing chassis, whilst protecting and guiding the power transmission means, and/or the controls therefor, whatever their nature may be.

Accordingly, the invention provides a vehicle for use on all kinds of ground, which vehicle comprises a leading chassis and a trailing chassis, one of the chassis carrying a power unit for the vehicle and the other chassis having motors driven by the power unit, the two chassis being connected together by a double-articulated coupling arranged to allow relative pivoting movement between the two chassis about two axes perpendicular to one another, the coupling providing a passage therethrough both for power transmission means from the power unit to the motors and for control means for the power unit and/or the motors.

According to a preferred embodiment of the invention, the coupling comprises a bushing for mounting on one of the chassis so that the axis of the bushing is essentially horizontal, there being a sleeve for connection to the other chassis, the sleeve being mounted co-axially within the bushing for rotation and held against axial movement with respect to the bushing, the bore of the sleeve providing the said passage for the power transmission means and

control means.

In this embodiment, the bushing is mounted in a cross-member of the chassis, and the ends of the bushing upstand from the faces of the cross-member, and the end of the sleeve nearest the other of the chassis is provided with a circular plate for bearing against the adjacent annular end face of the bushing, the plate being provided with two pairs of projections on its outwardly directed face, the projections of each pair being diametrically opposed and the pairs being on orthogonal diameters, and the other end of the sleeve being provided with thrust-bearing means for bearing against the other end face of the bushing.

Preferably, anti-friction means are provided between the adjacent faces of the plate and the bushing, between the external and internal surfaces of the sleeve and the bushing respectively, and between the adjacent faces of the bushing and the thrust-bearing means.

Advantageously, the said sleeve is provided with internal co-axial guiding means, such as at least two spacers adjacent the ends of the sleeve, for centring, guiding and protecting the power transmissions means and/or the control means.

It will be appreciated that this arrangement offers a protected central passage for guiding the power transmission means and/or control means.

It is preferred that one pair of projections extending from the plate towards the other chassis comprises flat and normally horizontal lugs lying in planes parallel with the axis of the sleeve and each being provided, adjacent its free end, with a bore for receiving an articulation pin for the sleeve, and the other pair of projections comprise normally horizontal fork-pieces arranged symmetrically with respect to the axis of the sleeve and each provided on its limbs with co-axial circular holes for receiving a pivot pin.

The lugs provided on the plate may co-operate with central projections attachable to the other chassis, and the fork pieces on the plate may be pivotally connected to jacks, which jacks are for pivotal connection to the other chassis.

Preferably the central projections are lugs each of which is provided with a bore adjacent its free end, the bore being adapted to receive a normally vertically extending articulation axle also passing through the lugs on the plate so as to provide a vertical axis of pivotting for the coupling, and the pivotal connection between the jacks and the other chassis each comprise a fork-piece attachable to the other chassis on the same horizontal level and symmetrically with respect to the fork-pieces on the plate, the chassis fork-pieces being spaced apart and each having a hole formed therein carrying a normally vertical pin, also passing through an aperture formed in the end of the associated jack.

Conveniently, these jacks can be hydraulically operated — i.e. they can comprise hydraulic rams.

In a vehicle for use over all kinds of ground and having a leading chassis and a trailing chassis connected together by a coupling as described above, the leading chassis may be provided with an axle having two wheels driven by independent hydraulic motors, and may have a driving and controlling position, and the trailing chassis also may have an axle provided with two wheels driven by independent hydraulic motors and may have a power unit with an internal combustion engine and hydraulic pumps for actuating the wheel motors, the power unit being located to the rear of the wheeled axle in order to serve as a counterweight for a load carried by the leading chassis.

Such an articulated vehicle can serve as basic unit for a number of applications in the fields of general handling, such as in construction yards, hoisting, towing and so on. It is notable for its working flexibility and its stability.

The manageability and manoeuvrability of the articulated vehicle are not reduced when the ground is very rough or undulating and hence when the two chassis are required to take up extreme angles. Risk of accidental damage to the transmission and/or control means passing through the coupling, during manoeuvring, is reduced to a very small degree.

By way of example only, one specific embodiment of the invention will now be described, reference being made to the accompanying drawings, in which:—

Figure 1 is a side view of a vehicle suitable for use on all kinds of ground, the chassis of which are connected by an articulation coupling constructed in accordance with the invention:

Figure 2 is a plan of the vehicle of Figure 1, but with its bonnets removed for clarity, the articulated coupling being shown partially in section;

Figure 3 is an enlarged and exploded perspective view of the central portion of the double articulated coupling according to the invention; and

Figure 4 is an enlarged view of part of the articulated coupling of Figure 1.

The preferred embodiment of the invention is shown in Figures 1, 2 and 4, in which there is shown an articulated vehicle comprising two chassis 1 and 2 connected by a double articulated coupling 3. Each

of these two chassis 1 and 2 is built around a beam 4, serving as an axle, at the ends of which are fitted hydraulic motors 5. In the shown example, each of these motors is of the type with a rotating casing and a fixed shaft.

Front chassis 1, hereafter referred to as the leading chassis, contains the driving position with the steering wheel, there being grouped around it all the levers for manoeuvring and controlling the vehicle. At the front portion of chassis 1 is a fork-lift mast 6 pivoted on shafts 7. Jacks 8, attached to a pivot 9 on the chassis 1, control the angle of the mast 6.

The rear chassis 2, hereafter referred to as the trailing chassis, also comprises a driving axle 4, and on a platform, the power unit for all the driving means of the vehicle — such as an internal combustion engine 10, hydraulic pumps 11 for actuating the motors 5, hydraulic pumps for controlling the angle of the mast and, for example, raising the fork lift 12. These driving means are mounted so that the centre of gravity of the power unit is, in all circumstances, located behind the driving axle 4, as far as possible to the rear thereof so as to serve as a counterweight for the load carried by the fork-lift, to assist the stability of the vehicle whilst working.

A double articulated coupling 3 connects the chassis 1 and 2 together, and plays the roll of a drawbar allowing relative movement of the two chassis in both senses; namely around a vertical pivoting axis for steering movements and around a horizontal pivoting axis for allowing the chassis, without straining, to correspond to the variations in level of the ground. This articulated coupling is described in detail hereafter.

The steering of the vehicle resulting from the relative pivoting of the chassis 1 and 2 around the vertical pivoting axis, is obtained by two jacks 13 activated by a steering hydro-static pump; the steering is thus effected by a known technique which will not be described in detail here.

The double articulated coupling 3 is especially designed for allowing the aforesaid relative movement of the chassis whilst providing a passage through its centre for any required power transmission and control means; in this particular embodiment these power transmission and control means include the hydraulic pipes for feeding the motors of front wheels 14, the necessary pipes and tubes for the operation of the hydraulically powered services, covered cables for the control of the engine, distribution controls regulating the flow from the hydrostatic pumps, and also electric cables — all of which, on Figure 2, are represented solely by the pipes 15 for feeding the motors 5 of the front axle with fluid under pressure.

Figures 2, 3 and 4 show details the construction of the articulated coupling.

For convenience, in this description "front" and "rear" as used in relation to different parts of the double articulated coupling 3, refer to those parts as normally fitted in position to connect the chassis, having regard to the normal direction of vehicle movement.

The leading chassis 1 has a rear cross member 16, having a bushing 17 provided centrally thereon which bushing is solidly welded or bolted to the cross-member. The axis of the bushing 17 is essentially horizontal and normal to the longitudinal axis of the cross-member 16. A sleeve 18 is arranged for free rotation in this bushing 17. The rear portion of bushing 17 projects slightly beyond the end face of cross-member 16 to provide an upstanding annular end face 19; the front face of the bushing also presents an annular face 20.

The sleeve 18 essentially comprises a central tubular portion 21 the rear end of which is provided with a circular plate 22; an annular portion of the front face of the plate 22 being in sliding contact with the end face 19 of bushing 17.

On the front end face of the tubular portion 21 is a thrust washer 23 connected thereto, for example, by bolts, the bore of the washer 23 essentially corresponding to that of the tubular portion 21 and the washer being in sliding contact with the front face 20 of the bushing 17. Thus, the sleeve 18 may rotate freely in the bushing 17 but may not move axially with respect to the bushing.

Plate 22 supports two pairs of projections; on the one hand lugs 24, 25, on the other hand, the fork-pieces 26, 27. The lugs 24, 25 are diametrically opposed, and normally lie in horizontal planes parallel to the axis of the sleeve 18. The lugs have co-axial holes 28, 29 intended to receive a vertical pivoting pin. The fork-pieces 26, 27 are also diametrically opposed and are equi-spaced from the lugs 24, 25, and thus normally horizontal so that they are symmetrical with respect to the horizontal pivoting axis.

The limbs of the fork-pieces 26, 27 extend outwardly and rearwardly and have, adjacent their free ends, co-axial holes 30, 31 and 32, 33 respectively, intended for receiving articulation pins which will be described below.

The trailing chassis has a cross-member 34 provided with fork-pieces 35, 36 for co-operation with the lugs 24, 25 projecting from the leading chassis, the cross-member 34 also being provided with jacks 13 connecting the fork-pieces 26, 27 to fixed ver-

tical articulation pins 37, 38.

The fork-pieces 35, 36 are attached to the cross-bar 34 and provide forks for receiving the lugs 24, 25, the fork-pieces 35, 36 having holes reamed therein for coincidence with those of lugs 24, 25. Pins 43, 44 connect together the fork-pieces 35, 36 and lugs 24, 25, respectively.

The articulation pins 37, 38 are mounted in fork-pieces 45, 46 attached symmetrically with regard the articulation axis of the front of chassis 2; these pins form pivotal attachment points for one of the ends of the jacks 13, the other ends of which are pivotally connected to the fork-pieces 26, 27 by pivot pins 47 or 48 respectively.

The above-described articulated coupling allows the two chassis to pivot around the vertical axis of the pins 43, 44 when either one of the jacks 13 are supplied with fluid under pressure; and relative rotation of the bushing 17 and the sleeve 18 allows the beam axles 4 of chassis 1 and 2 to take up different angular positions with regard to the horizontal, for example when one of the ground wheels mounts a rise or falls into a hollow. As has been pointed out, the sleeve 18 is axially immovable with respect to the bushing 17 so that, when the vehicle is in reverse, the trailing chassis 2 pulls the leading chassis 1.

So as to decrease the sliding or rotating frictions between the connected portions of the bushing 17 and the sleeve 18, an anti-friction washer 49 may be inserted between the face 20 of the bushing and the thrust washer 23; likewise an anti-friction bearing 50 (or a roller bearing) can be located between the bushing and the sleeve.

The freeness of the pivots between the fork-pieces 35, 36 attached to the trailing chassis and the solid lugs 24, 25 of the leading chassis can also be increased by inserting swivel bushes 52, 53 between the lugs and the axles 43, 44.

Sleeve 18 offers a passage for various kinds of pipes, controls and so on between the two chassis, the passage being protected from external wear, or damage. The centring and guiding of the pipelines and so on through the sleeve 18 can be improved by providing an internal lining of soft rubber, or more simply with washers (such as shown at 51 in Figures 3 and 4) located within the sleeve; contact with metallic edges, and the possibility of cutting is thus reduced.

The above-described arrangement of articulated chassis provides a basic structure suitable for a large number of vehicles for use on all kinds of ground, and having good stability; the chassis may be used for a fork-lift or for a digging shovel, winches for use in a forest, a hydraulic crane, a bucket loader and so on.

The invention is not limited to the constructional features of the above-described embodiment.

WHAT WE CLAIM IS:—

1. A vehicle for use on all kinds of ground, which vehicle comprises a leading chassis and a trailing chassis, one of the chassis carrying a power unit for the vehicle and the other chassis having motors driven by the power unit, the two chassis being connected together by a double-articulated coupling arranged to allow relative pivoting movement between the two chassis about two axes perpendicular to one another, the coupling providing a passage therethrough both for power transmission means from the power unit to the motors and for control means for the power unit and/or the motors.

2. A vehicle according to claim 1, wherein the coupling comprises a bushing for mounting on one of the chassis so that the axis of the bushing is essentially horizontal, there being a sleeve for connection to the other chassis, the sleeve being mounted co-axially within the bushing for rotation and held against axial movement with respect to the bushing, the bore of the sleeve providing the said passage for the power transmission means and control means.

3. A vehicle according to claim 2, wherein the ends of the bushing, when mounted in a cross-member of the chassis, upstand from the faces of the said cross-member, and the end of the sleeve nearest the other chassis is provided with a circular plate for bearing against the adjacent annular end face of the bushing, the plate being provided with two pairs of projections on its outwardly directed face, the projections of each pair being diametrically opposed and the pairs being on orthogonal diameters, and the other end of the sleeve being provided with thrust-bearing means for bearing against the other end face of the bushing.

4. A vehicle according to claim 3, wherein anti-friction means are provided between the adjacent faces of the plate and the bushing, between the external and internal surfaces of the sleeve and the bushing respectively, and between the adjacent faces of the bushing and the thrust-bearing means.

5. A vehicle according to claim 3 or claim 4, wherein one pair of projections comprises flat and normally horizontal lugs lying in planes parallel with the axis of the sleeve and each being provided, adjacent its free end, with a bore for receiving an articulation pin for the sleeve, and the

other pair of projections comprise normally horizontal fork-pieces arranged symmetrically with respect to the axis of the sleeve and each provided on its limbs with co-axial circular holes for receiving a pivot pin.

6. A vehicle according to claim 5, wherein the lugs provided on the plate co-operate with central projections attachable on the other chassis, and the fork-pieces on the plate are pivotally connected to jacks, which jacks are for pivotal connection to the other chassis.

7. A vehicle according to claim 6, wherein the central projections are lugs each of which is provided with a bore adjacent its free end, the bore being adapted for receiving a normally vertically extending articulation pin also passing through the lugs on the plate so as to provide a vertical axis of pivoting for the coupling, and the pivotal connections between the jacks and the other chassis each comprise a fork-piece attachable to the other chassis on the same horizontal level and symmetrically with respect to the fork-pieces on the plate, the chassis fork-pieces being spaced apart and each having a hole formed therein carrying a normally vertical pin, the pin also passing through an aperture formed in the end of the associated jack.

8. A vehicle according to claim 6, wherein the central projections for attachment to the other chassis are in the form of fork-pieces, between the limbs of which the lugs on the plate are located.

9. A vehicle according to any of claims 6 to 8, wherein the jacks comprise hydraulic rams.

10. A vehicle according to any of claims 2 to 9, wherein the sleeve contains co-axial guiding means within its interior, adapted for centring, guiding and protecting the transmission means and control means.

11. A vehicle according to any of claims 2 to 10, wherein the bushing is mounted on the leading chassis.

12. A vehicle according to any of the preceding claims, wherein the power transmission means utilises pressurised hydraulic fluid.

13. A vehicle according to any of the preceding claims, wherein the leading chassis has an axle provided with two wheels driven by independent hydraulic motors and has a driving and controlling position, and the trailing chassis also has an axle provided with two wheels driven by independent hydraulic motors, and has a power unit with an internal combustion engine and hydraulic pumps for actuating the wheel motors, the power unit being located to the rear of the wheeled axle in order to serve as a counterweight for a load carried by the leading chassis.

14. A vehicle according to any of the preceding claims, wherein the leading chassis is provided with a fork-lift mechanism on its front end.

15. A vehicle according to claim 1 and substantially as hereinbefore described, with reference to and as illustrated in the accompanying drawings.

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Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1976.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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2 SHEETS

COMPLETE SPECIFICATION

SHEET 1

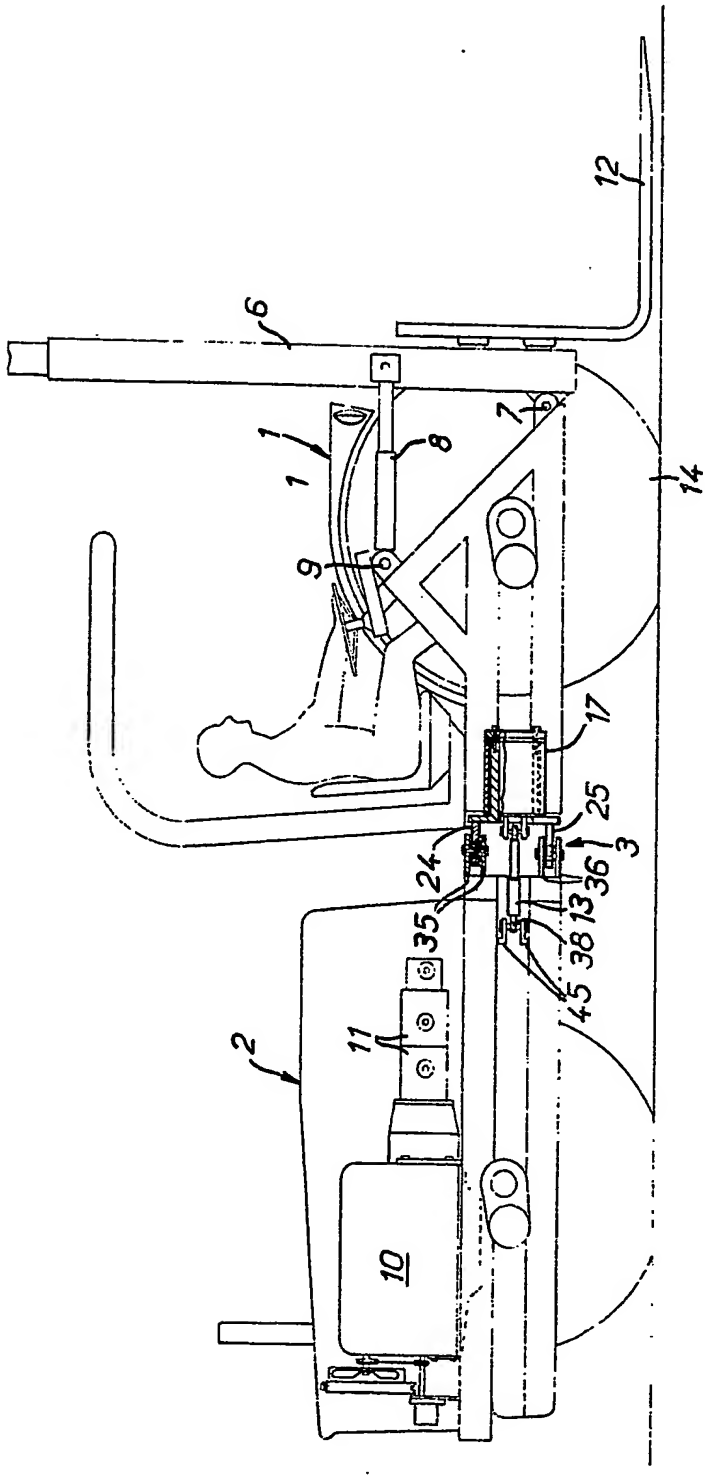

FIG. 1

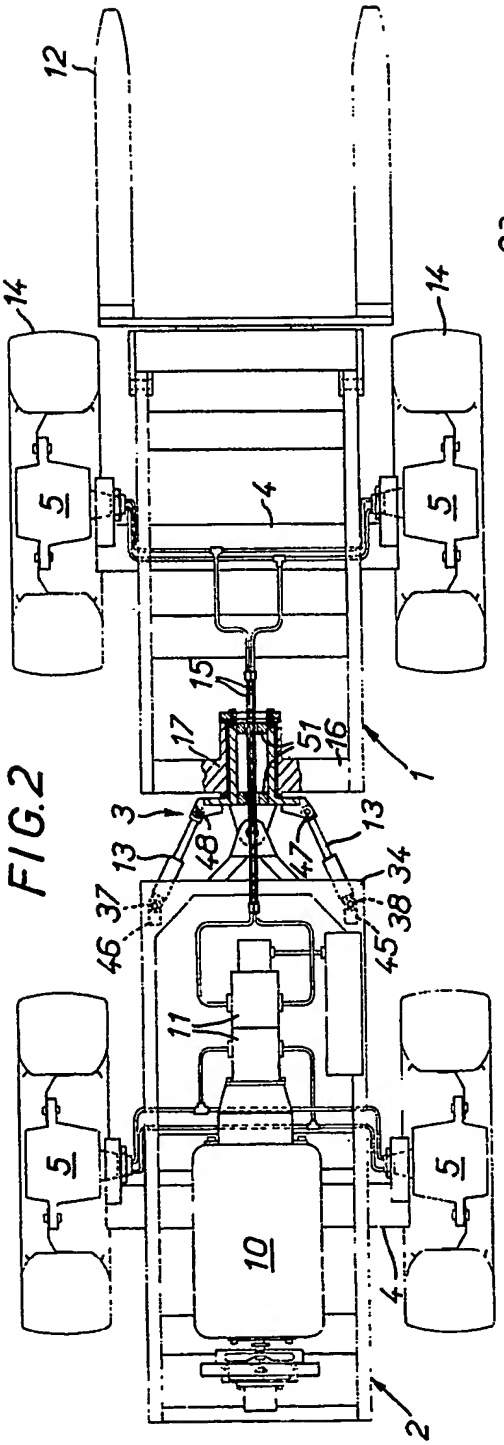

FIG.2

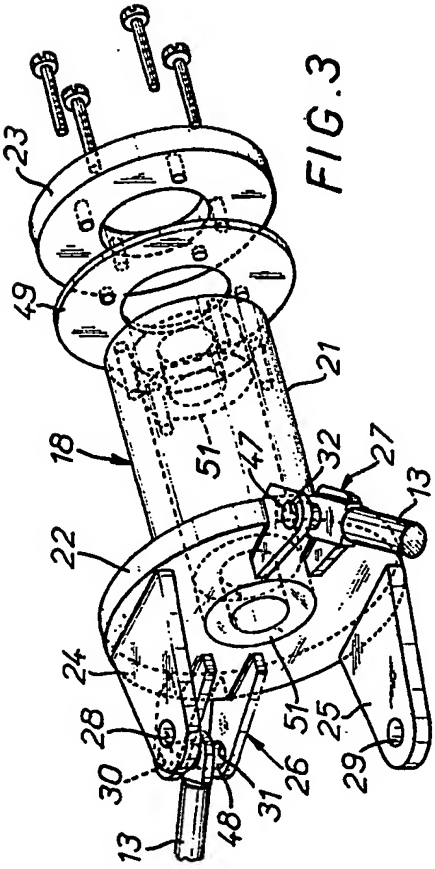

FIG.3

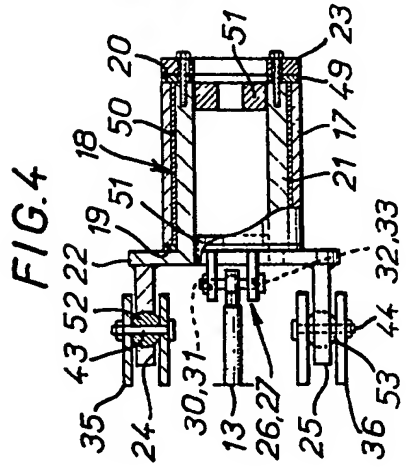

FIG.4